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| 08/988,246 | 12/01/97 | RAOUX S | AM1771-4-T19 |

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| EXAMINER | |
|---|---|
| ZERVIGON,R | |
| **ART UNIT** | **PAPER NUMBER** |
| 1763 | 12 |

**DATE MAILED:** 01/17/01

**Please find below and/or attached an Office communication concerning this application or proceeding.**

**Commissioner of Patents and Trademarks**

# Office Action Summary

| Application No. | Applicant(s) |
|---|---|
| 08/988,246 | Sebastien et al |
| **Examiner** | **Group Art Unit** |
| Rudy Zervigon | 1763 |

☒ Responsive to communication(s) filed on *Sep 27, 2000*

☐ This action is **FINAL.**

☐ Since this application is in condition for allowance except for formal matters, **prosecution as to the merits is closed** in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire *3* month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

**Disposition of Claim**

☒ Claim(s) *3-14 and 16-26* is/are pending in the applicat

Of the above, claim(s) *7-10* is/are withdrawn from consideration

☐ Claim(s) _____ is/are allowed.

☒ Claim(s) *3-6, 11-14, and 16-26* is/are rejected.

☐ Claim(s) _____ is/are objected to.

☐ Claims _____ are subject to restriction or election requirement.

**Application Papers**

☐ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

☐ The proposed drawing correction, filed on _____ is ☐ approved ☐ disapproved.

☐ The specification is objected to by the Examiner.

☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. § 119**

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some* ☒ None of the CERTIFIED copies of the priority documents have been

☐ received.

☐ received in Application No. (Series Code/Serial Number) _____.

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: _____

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

**Attachment(s)**

☐ Notice of References Cited, PTO-892

☐ Information Disclosure Statement(s), PTO-1449, Paper No(s). _____

☐ Interview Summary, PTO-413

☐ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

***— SEE OFFICE ACTION ON THE FOLLOWING PAGES —***

***Continued Prosecution Application***

1. The request filed on August 18, 2000 for a Continued Prosecution Application (CPA) under 37 CFR 1.53(d) based on parent Application No. 08/988,246 is acceptable and a CPA has been established. An action on the CPA follows.

***Claim Rejections - 35 USC § 103***

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 3,4,6,11-14,16-20, 22-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Salimian et al (U.S.Pat. 5,656,123) in view of Patrick et al (U.S.Pat. 5,474,648) and Kinoshita et al (U.S.Pat. 5,795,452), Maher et al (U.S.Pat. 5,248,371), Tadahiro Ohmi (U.S.Pat. 5,272,417). Salimian et al describe a plasma reactor suited to <u>both</u> additive and subtractive processes (column 1, lines 5-17). Specifically, Salimian et al describe:

i. A substrate processing system (item 10, Figure 1) using a deposition chamber (item 14, Figure 1; column 5, lines 38-64) encasing a reaction zone

ii. A substrate processing system using a substrate holder as a low frequency (LF) electrode (item 46, Figure 1; column 7, lines 27-34)

iii. A gas introduction system including a gas inlet (item 44, Figure 1) for supplying one or more process gas(es) to the reaction zone

iv. A high frequency (HF) electrode (column 7, lines 27-34)

v. A plasma power source (items 12, 16, Figure 1; column 5, lines 38-45) for forming plasma within the reaction zone of the additive or subtractive reaction zone (column 1, lines 5-17)

vi. impedance measuring of the HF electrode (column 7, lines 35-40)

vii. impedance measuring of the LF electrode (column 6, lines 24-28)

Salimian et al do not expressly meet the claim 11 limitations of an impedance monitor electrically coupled to each of the low and high frequency electrodes. Additionally, Salimian et al do not discuss a gas distribution system including a gas inlet manifold. Commonly in the art, a gas distribution system including a gas inlet manifold is referred to a showerhead that is customarily used as a counter electrode opposite the chamber electrode supporting the processed substrate. As such, a gas distribution system including a gas inlet manifold (showerhead) is well described in the art. The gas distribution system thus claimed is amply reflective in entire subclasses 204/432, 438/729, 118/723E, 156/345 and is demonstrated clearly by Maher et al (item 90 all figures, column 8, lines 52-65) who describes a plasma processing triode reactor (column 2, lines 41-49).

Tadahiro Ohmi additionally shadows the Salimian et al patent and complements the claim 11 limitations accordingly:

viii. A substrate processing system (Figure 1a) using a deposition chamber (item 105, Figure 1a; column 6, lines 25-38) encasing a reaction zone

ix. A substrate processing system using a substrate holder as a low frequency (LF) electrode (item 104, Figure 1a; column 6, lines 26-27)

x. A gas introduction system including a gas inlet (item , Figure ) for supplying one or more process gas(es) to the reaction zone

xi. A high frequency (HF) electrode (item 107, Figure 1a; column 6, lines 25-27)

xii. A plasma power source (items 111, 110, Figure 1a; column 6, lines 63-69) for forming plasma within the reaction zone of the additive or subtractive reaction zone (column 1, lines 5-17)

Roger Patrick et al (USPat5,474,648) details a dynamic control and delivery of radio frequency power in plasma process systems. **The processing is utilized to enhance the repeatability and uniformity of the process plasma. Power, voltage, current, phase, *impedance*, harmonic content and direct current bias of the radio frequency energy being delivered to the plasma chamber may be monitored at the plasma chamber and used to control or characterize the plasma load.** Dynamic pro-active control of the characteristics of the radio frequency power to the plasma chamber electrode during the formation of the plasma enhances the uniformity of the plasma (ABSTRACT).

In addition, according to the following excerpt from column 3, the claim 1 limitation of ***an impedance monitor electrically coupled to the deposition chamber to measure an impedance level*** **of the process plasma is explicitly met**:

ling the radio frequency energy with a computer system. In addition, the voltage, current, phase and impedance of the plasma chamber electrode may also be measured and the measurement information used by the computer power con-

From column 4:



trol system of the present invention.

A control system that monitors and controls the radio frequency power at the plasma chamber electrode is illustrated in FIGS. 2A and 2B. This radio frequency power control system includes a radio frequency sensor placed closely to the plasma load electrodes in the plasma etching

In addition the Patrick et al sensor may also measure the voltage, current and phase angle at the chamber electrode (items 112 and 114; column 6, line 64), ***and measure the chamber impedance (column 4, lines 37-40)***.

Patrick et al do not describe the following claim 11 attributes:

xiii. A substrate processing system **using a substrate holder as a low frequency (LF) electrode**

xiv. A high frequency (HF) electrode different from the **substrate holder as a low frequency (LF) electrode**

However, Patrick et al does discuss applying either or both HF or LF power to the chamber electrodes (column 1, lines 49-53). Patrick et al does precisely provide coupling of one power source to two counter electrodes with a measure of reactor impedance as described above. Kinoshita et al additionally describe this design (column 14, lines 12-20) as an embodiment in multiple embodiments of capacitively coupled plasma reactor designs (column 1, lines 5-15). Kinoshita et al does not provide, in the sixth embodiment, two power sources as is done in the fifth embodiment that very closely resembles the electrical orientation of the claimed components of the present invention. However, the Kinoshita et al item 17, Figure 7 component is provided as a phase shifter (column 13, line 49) not an impedance monitor as described according to item 17, Figure 7 (column 14, lines 12-20).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the Salimian et al plasma processing reactor in view of Patrick et al and, as demonstrated by Kinoshita et al with the common gas distribution showerhead electrode as described by Maher et al. Tadahiro Ohmi additionally anticipate collective attributes claimed in claim 11 as discussed above. By providing a chamber impedance measurement and control as described by Patrick et al into Salimian et al's two power source capacitively coupled reactor with different frequency positions, the Salimian et al inventors would arrive at the presently claimed invention under motivation provided by Patrick et al (column 3, lines 64-68 through column 4, lines 18).

4. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Salimian et al (U.S.Pat. 5,656,123) as applied to claims 3,4,6,11-14,16-20, 22-26 above, and further in view of Boys et al (U.S.Pat. 4,695,700). Boys et al describe a magnetron sputter coating apparatus controlled in response to measurements of plasma parameters to control deposition parameters (abstract). Specifically, Boys et al describe:

xv. a pressure control system (column 12, lines 51-53) configured to control a pressure level within the chamber and controllably coupled to the processor wherein the processor controls the pressure control system to vary the pressure within the chamber in response to the measured impedance level of the plasma (column 22, lines 61-66)

Boys et al do not describe all of the limitations set forth in claims 11. It would have been obvious to one of ordinary skill in the art at the time the invention was made to consider the pressure control system as described by Boys et al to be an obvious extension to the Patrick et al control system and impedance data collection and processing. Motivation for combining the above references follows from Patrick et al who provide rational for influencing control over plasma process parameters with impedance measurements(column 3, lines 64-68 through column 4, lines 18).

5. Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Salimian et al (U.S.Pat. 5,656,123) as applied to claims 3,4,6,11-14,16-20,22-26 above, and further in view of Grewal et al (U.S. Pat. 5,597,438). Grewal et al describes a three electrode etching chamber for selective and plasma processing of polycrystalline silicon (column 1, lines 1-12). Specifically, Grewal et al discusses:

xvi. A process chamber (item 30, Figure 2) for processing a semiconductor substrate (column 1, lines 1-12) in a plasma (column 1, lines 40-55) where the chamber consists of ...

xvii. A primary electrode (item 36, Figure 2; column 3, lines 3-25) on the ceiling of the process chamber which supports an electrically conducting surface ("electrode", column 3, line 5) exposed to the plasma zone

xviii. A secondary electrode (item 42 Figure 2; column 3,lines 3-25) comprising a conductor element having a surface exposed to the plasma and absent an insulator shield. The

secondary electrode is, additionally, below a third power electrode (item 48,Figure 2; column 3,lines 3-25).

xix. An electrode voltage supply adapted to maintain the power electrode, primary electrode, and secondary electrode at one or more different electrical potentials, thus *all power supplies are electrically coupled and controlled independently*, due to the three independently controlled power sources (column 3,lines 3-25). Floating electrical potentials for the secondary electrode is implicit considering the range of possible values the voltages may have depending on process conditions and set points. Each of the electrode voltage supplies are adapted to maintain the ceiling and the electrode at different electrical potentials.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the Salimian et al plasma processing reactor by implementing the independent source control as taught by Grewel at al to provide increased plasma volume geometric control (anisotropic) as discussed by Grewal et al (column 2, lines 5-20)

***Response to Arguments***

It is conceded that Patrick et al do not describe:

xx. A substrate processing system **using a substrate holder as a low frequency (LF) electrode**

xxi. A high frequency (HF) electrode different from the **substrate holder as a low frequency (LF) electrode**

However, Patrick et al does discuss applying either or both HF or LF power to the chamber electrodes (column 1, lines 49-53). In addition the Patrick et al sensor may also measure the voltage, current and phase angle at the chamber electrode (items 112 and 114; column 6, line 64), ***and measure the chamber impedance (column 4, lines 37-40)***.

It is conceded that Patrick et al do not have both LF and HF electrodes. However, Salimian et al remedy this deficiency:

xxii. impedance measuring of the HF electrode (column 7, lines 35-40)

xxiii. impedance measuring of the LF electrode (column 6, lines 24-28)

### *Conclusion*

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Examiner Rudy Zervigon whose telephone number is (703) 305-1351. The examiner can normally be reached on a Monday through Thursday schedule from 8am through 7pm. The official after final fax phone number for the 1763 art unit is (703) 305-3599. Any Inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Chemical and Materials Engineering art unit receptionist at (703) 308-0661. If the examiner can not be reached please contact the examiner's supervisor, Gregory L. Mills, at (703) 308-1633.

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